

**PATENT**

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the application of:

Masaki MORONUKI

Serial Number: Not Yet Assigned

Filed: May 8, 2001

For: AMORPHOUS HARD CARBON FILM, MECHANICAL PARTS AND METHOD FOR  
PRODUCING AMORPHOUS HARD CARBON FILM

**PRELIMINARY AMENDMENT**

Assistant Commissioner

For Patents

Washington, D.C. 20231

May 8, 2001

Sir:

Prior to calculation of the fee and examination on the merits  
of the above-identified patent application, please amend the  
application as follows:

**IN THE CLAIMS:**

Please amend claims 4 and 6-12 to read as follows:

4. (Amended) Mechanical part having a sliding portion,  
characterized in that the sliding portion is coated with an  
amorphous hard carbon film mainly comprising carbon and hydrogen  
and metal oxide.

6. (Amended) Mechanical part according to claim 4, wherein said amorphous hard carbon film has hardness of from Vickers 1800 to 2500.

7. (Amended) Mechanical part according to claim 4, wherein said amorphous hard carbon film is from 2 to 15  $\mu\text{m}$  thick.

8. (Amended) Mechanical part according to claim 4, wherein the mechanical part is a piston ring.

9. (Amended) Mechanical part according to claim 4, wherein said mechanical part is a vane of a compressor.

10. (Amended) Mechanical part according to claim 1, wherein the mechanical part is a plunger of a fuel-injecting pump.

11. (Amended) A method for forming an amorphous hard carbon film, characterized in that carbon material, metal-containing material and oxygen are introduced into a vacuum chamber where a substrate is placed, thereby forming an amorphous hard carbon film,

in which metal oxide is contained.

12. (Amended) A method for forming an amorphous hard carbon film, characterized in that carbon material, metal-containing material and oxygen-containing material are introduced into a vacuum chamber where a substrate is placed, thereby forming an amorphous hard carbon film, in which metal oxide is contained.

Please add claims 13-19.

13. (New) Mechanical part according to claim 5, wherein said amorphous hard carbon film has hardness of from Vickers 1800 to 2500.

14. (New) Mechanical part according to claim 5, wherein said amorphous hard carbon film is from 2 to 15  $\mu\text{m}$  thick.

15. (New) Mechanical part according to claim 5, wherein the mechanical part is a piston ring.

16. (New) Mechanical part according to claim 5, wherein said mechanical part is a vane of a compressor.

17. (New) Mechanical part according to claim 2, wherein the mechanical part is a plunger of a fuel-injecting pump.

18. (New) Mechanical part according to claim 3, wherein the mechanical part is a plunger of a fuel-injecting pump.

19. (New) Mechanical part according to claim 4, wherein the mechanical part is a plunger of a fuel-injecting pump.

REMARKS

Claims 4 and 6-12 have been amended to remove multiple dependencies and to conform with standard United States Patent practice. New claims 13-19 have been added to cover embodiments deleted by the amendments to the original claims.

Attached hereto is a marked-up version of the changes made to the specification and claims by the current amendment. The attached page is captioned "VERSION WITH MARKINGS TO SHOW CHANGES MADE."

In the event any additional fees are required, please charge our Deposit Account No. 111833.

Respectfully submitted,

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS:

Claims 4, and 6-12 have been amended as follows:

4. (Amended) Mechanical part [~~10, 12, 30, 42~~] having a sliding portion, characterized in that the sliding portion is coated with an amorphous hard carbon film [~~12~~] mainly comprising carbon and hydrogen and metal oxide.

6. (Amended) Mechanical part according to claim 4 [~~or 5~~], wherein said amorphous hard carbon film [~~12~~] has hardness of from Vickers 1800 to 2500.

7. (Amended) Mechanical part according to claim 4 [~~or 5~~], wherein said amorphous hard carbon film [~~12~~] is from 2 to 15  $\mu\text{m}$  thick.

8. (Amended) Mechanical part according to [~~any one of~~]

[elaims] claim 4 [~~through 7~~], wherein the mechanical part is a piston ring [~~(42)~~].

9. (Amended) Mechanical part according to [~~any one of~~] [elaims] claim 4 [~~through 7~~], wherein said mechanical part is a vane [~~(20)~~] of a compressor.

10. (Amended) Mechanical part according to [~~any one of~~] [elaims] claim 1 [~~through 4~~], wherein the mechanical part is a plunger [~~(30)~~] of a fuel-injecting pump.

11. (Amended) A method for forming an amorphous hard carbon film, characterized in that carbon material, metal-containing material and oxygen are introduced into a vacuum chamber [~~(1, 41)~~] where a substrate [~~(10)~~] is placed, thereby forming an amorphous hard carbon film, in which metal oxide is contained.

12. (Amended) A method for forming an amorphous hard carbon film, characterized in that carbon material, metal-containing material and oxygen-containing material are introduced into a

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vacuum chamber [~~1, 41~~] where a substrate [~~10~~] is placed, thereby forming an amorphous hard carbon film, in which metal oxide is contained.

New claims 13-19 have been added.

13. (New) Mechanical part according to claim 5, wherein said amorphous hard carbon film has hardness of from Vickers 1800 to 2500.

14. (New) Mechanical part according to claim 5, wherein said amorphous hard carbon film is from 2 to 15  $\mu\text{m}$  thick.

15. (New) Mechanical part according to claim 5, wherein the mechanical part is a piston ring.

16. (New) Mechanical part according to claim 5, wherein said mechanical part is a vane of a compressor.

17. (New) Mechanical part according to claim 2, wherein



the mechanical part is a plunger of a fuel-injecting pump.

18. (New) Mechanical part according to claim 3, wherein  
the mechanical part is a plunger of a fuel-injecting pump.

19. (New) Mechanical part according to claim 4, wherein  
the mechanical part is a plunger of a fuel-injecting pump.